[MVA] - Rapport de stage

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1 Introduction

Continual learning is a machine learning paradigm that focuses on the ability of a model to learn and adapt to new information over time, without forgetting previously learned knowledge. It is particularly relevant in scenarios where data is non-stationary or arrives in a sequential manner. By leveraging techniques such as online learning, regularization, and knowledge distillation, continual learning enables models to continuously update their knowledge and improve performance as new data becomes available.

1.1 Initial project

> *The aim of this project is to explore the integration of Gradmax with our dynamic 'Mosaic' architecture. We plan to approach this by factoring hardware limitations into the optimization process. In addition, we're considering the development of a gating network within this architecture that determines the optimal timing for assigning tasks to newly added neurons. This could leverage cutting-edge techniques like Mixture of Expert models.*

1.2 Revised project

References

[1] Thomas Dalgaty et al. "Mosaic: in-memory computing and routing for small-world spike-based neuromorphic systems". In: *Nature Communications* 15.1 (Jan. 2024). ISSN: 2041-1723. DOI: 10.1038/s41467-023-44365-x. URL: http://dx.doi.org/10.1038/s41467-023-44365-x.

[2] David Eigen, Marc'Aurelio Ranzato, and Ilya Sutskever. *Learning Factored Representations in a Deep Mixture of Experts*. 2014. arXiv: 1312.4314 [cs.LG].

[3] Jason K. Eshraghian et al. *Training Spiking Neural Networks Using Lessons From Deep Learning*. 2023. arXiv: 2109.12894 [cs.NE].

[4] Utku Evci et al. *GradMax: Growing Neural Networks using Gradient Information*. 2022. arXiv: 2201.05125 [cs.LG].

[5] Ziming Liu et al. *Growing Brains: Co-emergence of Anatomical and Functional Modularity in Recurrent Neural Networks*. 2023. arXiv: 2310.07711 [q-bio.NC].

[6] Javier Lopez Randulfe and Leon Bonde Larsen. *A multi-agent model for growing spiking neural networks*. 2020. arXiv: 2010.15045 [cs.NE].

[7] Xin Yuan, Pedro Savarese, and Michael Maire. *Accelerated Training via Incrementally Growing Neural Networks using Variance Transfer and Learning Rate Adaptation*. 2023. arXiv: 2306.12700 [cs.LG].